

### **Chapter 3. Environmental Law and Regulations: From End-of-Pipe to Pollution Prevention**

*by*  
*David R. Shonnard*

Chemical engineers practice a profession and must obey rules governing their professional conduct. One important set of rules that all chemical engineers should be aware of is environmental statutes, which are laws enacted by Congress. Regulations are promulgated by administrative agencies based on authority conferred by the statute. The Environmental statutes are designed to protect human health and the environment by placing limits on the quantity and chemical make-up of waste streams that are released from manufacturing processes. For example, one statute places restrictions on how hazardous waste from industry is stored, transported, and treated. Another statute places strict liability on the generators of hazardous waste, requiring responsible parties to clean up disposal sites that fail to protect the environment. For manufacturers of new chemicals, there are regulatory requirements that required filing of a premanufacture notice (PMN) before introducing a new chemical into the marketplace. While many companies have Health, Safety, and Environment (HS&E) staff that can help the engineer interpret and implement environmental requirements, it is nevertheless important that chemical engineers be aware of prominent federal environmental laws, and adhere to the requirements of these statutes.

The purpose of this chapter is to provide an overview of environmental regulation. Much of the material on regulations in this chapter has been adapted from an excellent review of environmental law by Lynch (1995). More comprehensive sources on this topic include the United States Code (U.S.C.), and the Code of Federal Regulations (C.F.R.), which are sets of environmental statutes and regulations, respectively; they are available online at the site maintained by the federal government printing office. The Environmental Law Handbook (Sullivan and Adams, 1997) and West's Environmental Law Statutes (West Publishing Co.) are compendia of existing statutes. Most of these sources can be found online.

There are approximately 20 federal statutes, hundreds of state and local ordinances, thousands of federal and state regulations, and even more federal and state court cases and administrative adjudications, etc., that deal with environmental issues. Taken together, they make up the field of environmental law, which has seen explosive growth in the last 30 years, as shown in Figure 3.1-1. Chemical engineers should be familiar with environmental laws and regulations because they affect the operation of chemical processes and the professional responsibilities of chemical engineers. *Environmental regulations* and the *common law system* of environmental law require actions by affected entities. For example, the Clean Water Act (an environmental statute) requires facilities that discharge pollutants from a point source into navigable waters in the United States to apply for a national pollutant discharge elimination system (NPDES) permit. In many firms, chemical engineers are responsible for applying for and obtaining these permits. The common law created by judicial decision also encourages chemical engineers to act

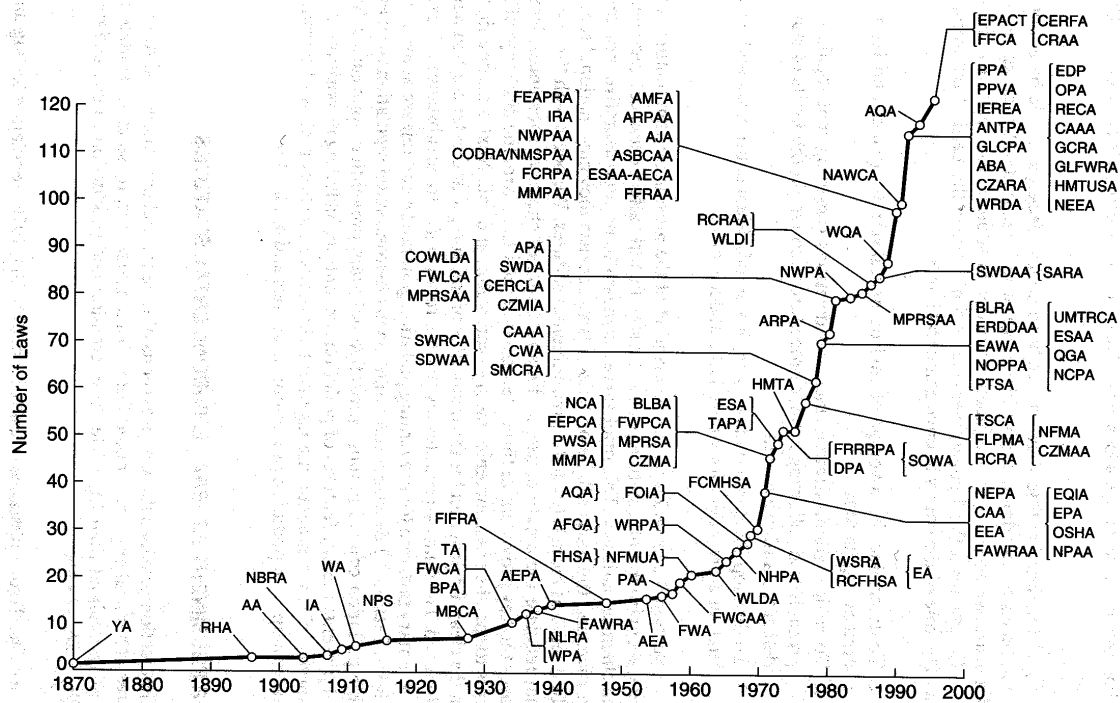


Figure 3.1-1 Cumulative growth in the federal environmental laws and amendments.

responsibly when performing their professional duties because environmental laws and regulation do not cover every conceivable environmental wrong. Chemical engineers need to be aware of the potential legal liability resulting from violation of environmental laws and regulations to protect their company and themselves from legal and administrative actions.

The sources of environmental laws and regulations are legislatures, administrative agencies, and the courts. When drafting environmental laws, federal and state legislatures often use broad language to describe the objectives, regulatory programs, and enforcement provisions of the statute. Often, legislators do not have the time or resources to implement the statute and therefore leave the detailed development of regulations to administrative agencies. Administrative agencies, such as the Environmental Protection Agency, give meaning to statutory provisions through a procedure known as rule making. Federal rule making consists of giving notice of proposed new regulations by publication in the *Federal Register*, providing an opportunity for public comment, altering the proposed rule, where appropriate, to incorporate the comments received, and publishing final regulations in the *Federal Register*. Final rules have the force of law. As such, administrative agencies fulfill a legislative function delegated to them by Congress.

Administrative agencies can be created by the executive or legislative branches of government. In 1970, President Nixon established the United States Environmental

Protection Agency by executive order to consolidate federal programs for regulating air and water pollution, radiation, pesticides, and solid waste disposal. However, administrative agencies are most often established by statute (for example, the Occupational Safety and Health Act established the Occupational Safety and Health Administration), and in these cases, the agency powers are derived from their enabling legislation. Administrative agencies also have the authority to resolve disputes that arise from the exercise of their administrative powers. Regulated entities have the right to appeal decisions made by administrative agencies to an administrative law judge, who is appointed by the agency. Thus administrative agencies have a judicial function in addition to a legislative function.

Courts are a third government actor that helps to define the field of environmental law. The role of the courts in environmental law is:

1. To determine the coverage of environmental statutes (which entities are covered by regulations);
2. To review administrative rules and decisions (ensuring that regulations are promulgated following proper procedures and within the limits of statutorily delegate authority); and
3. To develop the common law (a record of individual court cases and decisions that set a precedent for future judicial decisions).

Section 3.2 provides a brief description of the most important features of nine federal environmental statutes that most significantly affect chemical engineers and the chemical industry. This brief survey is meant to be representative, not comprehensive, and the focus will be on federal laws because they have national scope and often serve as models for state environmental statutes. We begin with three statutes that regulate the creation, use, and manufacture of chemical substances. Next, we cover the key provisions of three statutes that seek to control the discharge of pollutants to specific environmental media—air, water, and soil. Next, a statute that initiated a clean-up program for the many sites of soil and groundwater contamination is discussed. The final two statutes involve the reporting of toxic substance releases and a voluntary program for preventing pollution generation and release at industrial facilities. Section 3.3 describes the evolution in environmental regulation from end-of-pipe pollution control to more proactive pollution prevention approaches. Section 3.4 presents the key features of pollution prevention, including its position in the hierarchy of environmental management alternatives, a short review of terminology, and examples of pollution prevention strategies and applications.

### Chapter 3 Example Table

Table 3.1 Summary Table for Environmental Laws

Environmental Statute	Date Enacted	Background	Key Provisions
<i>Regulation of Chemical Manufacturing</i> The Toxic Substances Control Act (TSCA)	1976	Highly toxic substances, such as polychlorinated biphenyls (PCBs), began appearing in the environment and in food supplies. This prompted the federal government to create a program to assess the risks of chemicals before they are introduced into commerce.	Chemical manufacturers, importers, or processors, must submit a report detailing chemical and processing information for each chemical. Extensive testing by companies may be required for chemicals of concern. For newly created chemicals, a Premanufacturing Notice must be submitted.
The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)	Enacted, 1947 Amended, 1972	Because all pesticides are toxic to plants and animals, they may pose an unacceptable risk to human health and the environment. FIFRA is a federal regulatory program whose purpose is to assess the risks of pesticides and to control their usage so that any exposure that may result poses an acceptable level of risk.	Before any pesticide can be distributed or sold in the U.S., it must be registered with the EPA. The data is difficult and expensive to develop and must prove that the chemical is effective and safe to humans and the environment. Labels must be placed on pesticide products that indicate approved uses and restrictions.
The Occupational Safety and Health Act (OSH Act)	1970	The agency that oversees the implementation of the OSH Act is the Occupational Safety and Health Administration (OSHA). All private facilities having more than 10 employees must comply with the OSH Act requirements.	Companies must adhere to all OSHA health standards (exposure limits to chemicals) and safety standards (physical hazards from equipment). The OSH Act's Hazard Communication Standard requires companies to develop hazard assessment data (material safety data sheet (MSDS), label chemical substances, and inform and train employees in the safe use of chemicals.

Table 3.1 Continued; Summary Table for Environmental Laws

Environmental Statute	Date	Background	Key Provisions
<i>Regulation of Discharges to the Air, Water, and Soil</i> Clean Air Act (CAA)	1970	The CAA is intended to control the discharge of air pollution by establishing uniform ambient air quality standards that are in some instances health-based and in others, technology-based. The CAA also addresses specific air pollution problems such as hazardous air pollutants, stratospheric ozone depletion, and acid rain.	The CAA established the National Ambient Air Quality Standards (NAAQS) for maximum concentrations in ambient air of CO, Pb, NO <sub>2</sub> , O <sub>3</sub> , particulate matter, and SO <sub>2</sub> . States must develop source-specific emission limits to achieve the NAAQS. States issue air emission permits to facilities. Stricter requirements established for hazardous air pollutants (HAPs) and for new sources.
Clean Water Act (CWA)	1972	The Clean Water Act (CWA) is the first comprehensive federal program designed to reduce pollutant discharges into the nation's waterways ("zero discharge" goal). Another goal of the CWA is to make water bodies safe for swimming, fishing, and other forms of recreation ("swimmable" goal). This act is considered largely successful because significant improvements have been made in the quality of the nation's waterways since its enactment.	The CWA established the National Pollutant Discharge Elimination System (NPDES) permit program that requires any point source of pollution to obtain a permit. Permits contain either effluent limits or require the installation of specific pollutant treatment. Permit holders must monitor discharges, collect data, and keep records of the pollutant levels of their effluents. Industrial sources that discharge into sewers must comply with EPA pretreatment standards by applying the best available control technology (BACT).
Resource Conservation and Recovery Act (RCRA)	1976	The Resource Conservation and Recovery Act was enacted to regulate the "cradle-to-grave" generation, transport, and disposal of both non-hazardous and hazardous wastes to land, encourage recycling, and promote the development of alternative energy sources	Generators must maintain records of the quantity of hazardous waste generated, where the waste was sent for treatment, storage, or disposal, and file this data in biennial reports to the EPA. Transporters and disposal facilities must adhere to similar requirements for record keeping as well as for monitoring the environment.

		based on solid waste materials.	
--	--	---------------------------------	--

Table 3.1 Continued; Summary Table for Environmental Laws

Environmental Statute	Date Enacted	Background	Key Provisions
<i>Clean-Up, Emergency Planning, and Pollution Prevention</i>			
The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)	1980	CERCLA began a process of identifying and cleaning up the many sites of uncontrolled hazardous waste disposal at abandoned sites, industrial complexes, and federal facilities. EPA is responsible for creating a list of the most hazardous sites of contamination, which is termed the National Priority List (NPL). It was amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.	After a site is listed in the NPL, EPA identifies potentially responsible parties (PRPs) and notifies them of their potential CERCLA liability, which is strict, joint and several, and retroactive. PRPs are 1) present or 2) past owners of hazardous waste disposal facilities, 3) generators of hazardous waste, and 4) transporters of hazardous waste.
The Emergency Planning and Community Right to Know Act (EPCRA)	1986	Title III of (SARA) contains a separate piece of legislation called the (EPCRA). There are two main goals of EPCRA; 1) to have states create local emergency units that must develop plans to respond to chemical release emergencies, and 2) to require EPA to compile an inventory of toxic chemical releases to the air, water, and soil from manufacturing facilities.	Facilities must work with state and local entities to develop emergency response plans in case of an accidental release. Affected facilities must report annually to EPA data on the maximum amount of the toxic substance on-site in the previous year, the treatment and disposal methods used, and the amounts released to the environment or transferred off-site for treatment and/or disposal.
Pollution Prevention Act (PPA)	1990	The act established pollution prevention as the nation's primary pollution management strategy with emphasis on source reduction. Established a Pollution Prevention Information Clearinghouse whose goal is to compile source reduction information and make it available to the public.	The only mandatory provisions of the PPA requires owners and operators of facilities that are required to file a Form R under the SARA Title III to report to the EPA information regarding the source reduction and recycling efforts that the facility has undertaken during the previous year.

### Chapter 3 Sample Homework Problem

1. Categorize the following solvent recovery operation in terms of the waste management hierarchy. Discuss the pollution prevention features of this process. Determine whether this process is pollution prevention or not. Use both the federal definition and also the expanded definition adopted in this text.

Process Description: The automotive industry uses robots to paint automobile bodies before attaching them to the chassis, and installing other components such as the drive train, lights, trim, and upholstery. In order to accommodate different colors, the paint lines must be flushed with a solvent and then re-charged with the new color paint. In the past, this solvent and paint residue was disposed of as hazardous waste or incinerated. The current process of spray painting automobiles uses a closed-loop solvent recovery process as outlined in the diagram below (Gage Products, Ferndale, MI).

